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SYSTEMATIC REVIEW

EFFECTIVENESS OF PHYSICAL THERAPIST ADMINISTERED SPINAL MANIPULATION FOR THE TREATMENT OF LOW BACK PAIN: A SYSTEMATIC REVIEW OF THE LITERATURE

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ABSTRACT

Background Context: Low back pain (LBP) is a prevalent disorder in society that has been associated with increased loss of work time and medical expenses. A common intervention for LBP is spinal manipulation, a technique that is not specific to one scope of practice or profession.

Purpose: The purpose of this systematic review was to examine the effectiveness of physical therapy spinal manipulations for the treatment of patients with low back pain.

Methods: A search of the current literature was conducted using PubMed, CINAHL, SPORTDiscus, Pro Quest Nursing and Allied Health Source, Scopus, and Cochrane Controlled Trials Register. Studies were included if each involved: 1) individuals with LBP; 2) spinal manipulations performed by physical therapists compared to any control group that did not receive manipulations; 3) measurable clinical outcomes or efficiency of treatment measures, and 4) randomized control trials. The quality of included articles was determined by two independent authors using the criteria developed and used by the Physiotherapy Evidence Database (PEDro).

Results: Six randomized control trials met the inclusion criteria of this systematic review. The most commonly used outcomes in these studies were some variation of pain rating scales and disability indexes. Notable results included varying degrees of effect sizes favoring physical therapy spinal manipulations and minimal adverse events resulting from this intervention. Additionally, the manipulation group in one study reported statistically significantly less medication use, health care utilization, and lost work time.

Conclusion: Based on the findings of this systematic review there is evidence to support the use of spinal manipulation by physical therapists in clinical practice. Physical therapy spinal manipulation appears to be a safe intervention that improves clinical outcomes for patients with low back pain.

Keywords: Low back pain, manipulation, manual therapy, spine

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INTRODUCTION

Low back pain (LBP) is a common, disabling disorder that places a burden on individuals and society, resulting in associated loss of work productivity and increased medical costs.[1-3] It has been proposed that LBP has a point prevalence of 6% to 33%[4-6] and 1-year prevalence of 22% to 65%.[4,6] Lifetime prevalence of LBP has been suggested to be approximately 84%.[7] However, this estimate is likely to fluctuate from study to study based on the variable definitions of LBP, patient populations studied, and study design.[8]

Spinal manipulation is a common, safe intervention that is applied to patients with various forms of low back pain. By definition, spinal manipulation is a localized or globally applied, single, quick, and forcible movement, alternately termed "high-velocity thrust", of small amplitude, following careful positioning of the patient.[9] The procedure is differentiated from mobilization in that a thrust is applied during the technique, versus lower velocity repetitive oscillations or sustained holds.[10] Spinal manipulation has been advocated in clinical practice guidelines for low back pain,[11] with evidence that exists to support the use of spinal manipulation for improvement of pain and function in patients with acute LBP.[4,12] In contrast, there are conflicting reports on the effectiveness of spinal manipulation for chronic LBP.[1,12-15]

Spinal manipulative therapy is used by a number of healthcare professions, including physical therapists, chiropractors, osteopathic physicians, and medical physicians. The use by physical therapists (PT) has been challenged regarding whether manipulation falls within their scope of clinical practice.[16] A 2004 survey suggested that spinal manipulative therapy is a treatment technique that is taught to the majority of physical therapy students during didactic and clinical training.[17] Although initially underutilized by physical therapists, momentum and adherence to evidence-based practice have enhanced the efforts to improve clinical reasoning for selection and delivery of such techniques.[18] Concurrent with the increased use in the clinic have been published contributions by physical therapists on the effectiveness of spinal manipulation, and the recognition of these publications by other healthcare professions.[19] Yet, to the authors' knowledge, there has been no successful attempt to effectively and comprehensively define outcomes associated with physical therapy manipulation and describe the effectiveness of this intervention for patients with low back pain.

The objective of this systematic review was to analyze the effectiveness of physical therapy spinal manipulations for the treatment of patients with LBP. Effectiveness was determined by analyzing studies that compared physical therapy spinal manipulations with other interventions and included at least one clinically relevant outcome measure. Additionally, adverse effects, or unintended consequences of treatment,[20] were taken into consideration when determining the effectiveness of this intervention. Findings from this systematic review may improve the understanding of whether spinal manipulative therapy, when performed by physical therapists, is a useful clinical procedure in practice.

METHODS

Study Design

The authors of this systematic review used the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines during the search and reporting phase. The PRISMA Statement is composed of a 27-item checklist and a four-phase flow diagram which assists in reporting systematic reviews and meta-analyses.[21] PRISMA can be used to report systematic reviews of various forms of research, most notably randomized controlled trials.[19] These guidelines are helpful prospectively in the design and framework of a systematic review, but are not designed for use in retrospective assessment of quality.

Eligibility Criteria

Decisions for inclusion of published studies were based on the following Population, Intervention, Control, Outcomes, and Study design (PICOS) criteria[22] defined for this systematic review as:

Population: Individuals with low back pain

Intervention: Spinal manipulations performed by physical therapists

Control: Any control group which did not receive physical therapy manipulation

Outcomes: Clinical outcomes (ie. quality of life, pain, disability) and efficiency of treatment (ie. costs, treatment time frame, number of visits, return to work)

Study Design: Randomized controlled trials (RCTs)

Only studies published in English were considered for review. Studies had to compare spinal manipulation to any other treatment approach and clearly distinguish spinal manipulation from other manual interventions. Manipulation had to be recognized as a high velocity-low amplitude (HVLA) thrust technique. Also, each article needed to clearly report that the spinal manipulations were performed exclusively by physical therapists. During instances in which this information was not clearly reported, the appropriate authors were contacted for clarification.

Information Sources

Individualized, computer-based search strategies for PubMed, CINAHL, Scopus, SPORTDiscus, ProQuest Nursing & Allied Health Source, and Cochrane Central Register of Controlled Trials databases (Appendix 1) were developed on May 14, 2012.

Search

PubMed was searched using a comprehensive search strategy that included search terms related to spinal manipulation for low back pain. There were no limits applied to the publication date of articles, but the following limits were applied to the search results: (1) Humans and (2) studies published in English. All remaining databases were searched using comparable strategies (Appendix 1).

Study Selection

The review process was performed by two independent authors (using a third author to resolve disagreements) for the 1) title search, 2) abstract search, and 3) full text search. Reasons for excluding full-text articles were documented. Kappa values were calculated as a measure of interrater reliability for agreement between title, abstract, and full-text reviewers. Commonly, kappa scores are interpreted as poor (<0.20), fair (0.21-0.40), moderate (0.41-0.60), strong (0.61-0.80, or near complete agreement (>0.80).[23]

Data collection process

Data was extracted from each article by one author and a second author verified the information regarding methods, outcome measures, and adverse effects. The extracted information related to methods was as follows: (1) study type; (2) study setting and population; (3) description of physical therapy manipulation for experimental group; (4) description of intervention for control group; and (5) outcome measures. The extracted information related to outcome measures was as follows: (1) group means at baseline and each follow-up point or mean differences and 95% confidence intervals and (2) statistical significance of group differences. The extracted information related to adverse effects was as follows: (1) type of adverse event; (2) number of adverse events resulting from physical therapy manipulation; and (3) number of adverse events resulting from other interventions.

Risk of Bias

Each full-text article was reviewed independently by two authors and scored with the PEDro quality assessment tool.[24] Disagreements in scoring were determined by consensus. This retrospective tool was designed to evaluate the internal validity and statistical reporting of randomized control trials. A higher rating on the PEDro scale is indicative of a study of better quality.

Synthesis of results

The results from reported outcome measures were synthesized to determine whether the manipulation group was considered superior, equal, or inferior to the control group based on the statistical significance reported in the studies. If studies reported mean differences and standard deviations a Cohen's effect size was calculated. Cohen's *d* effect sizes are magnitude measures that describe the extent of the improvement of one group over another. Effect sizes typically are interpreted as minimal (0.20), moderate (0.50), or large (0.80).[25]

RESULTS

Study selection

The database searches resulted in a total of 2,943 total citations that were reviewed for inclusion. After screening, 52 full-text articles were reviewed and six were deemed eligible.[26-31] In all six studies spinal manipulation was provided to the low back. Reasons for excluding full-text articles included non-randomized controlled trials ($n=10$), spinal manipulations not provided by physical therapists ($n=19$),

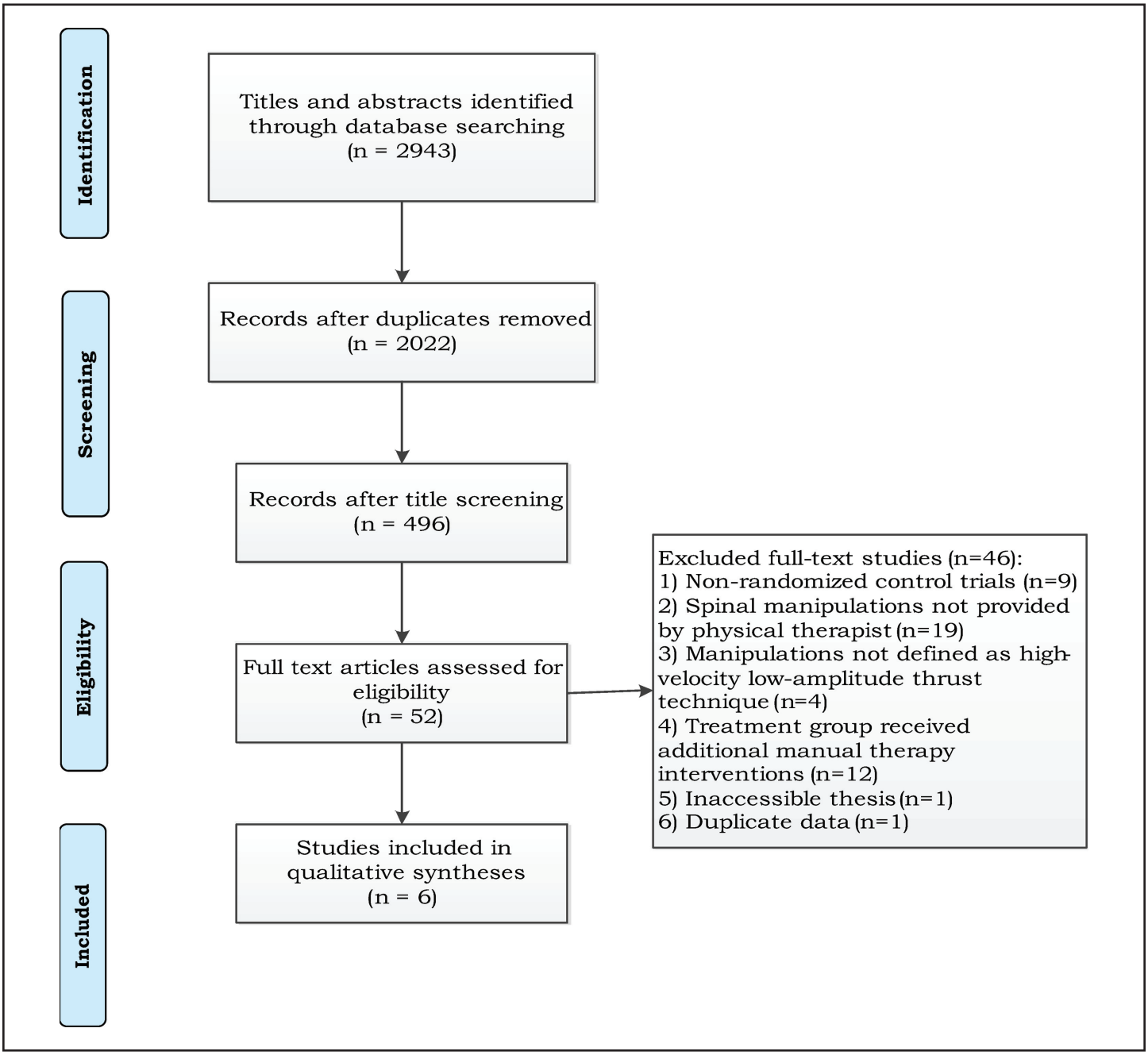

Figure 1. *Study flow for the systematic review.*

manipulations not defined as high-velocity low-amplitude thrust technique (n = 4), treatment group received high-velocity low-amplitude thrust manipulation with additional manual therapy (n = 12), one published thesis was inaccessible through our institution's library (n = 1), and use of duplicate data (n = 1). Figure 1 provides an explanation of the methods to obtain the final list of full-text articles. The calculated kappa scores for the inter-rater reliability of title reviews, abstract reviews, and full-text reviews were 0.830 (95% CI = 0.802, 0.853), 0.862 (95% CI = 0.767, 0.897), and 0.912 (95% CI = 0.480, 0.912), respectively. In general there was a lack of homogeneity among inclusion criteria, outcomes measures, and length of data collection, thus, the authors elected not to perform a meta-analysis.

Study characteristics

Of the six studies included, four were retrieved from PubMed[26-29] and two from CINAHL.[30,31] These studies

were published between 2004 and 2009. The full details of all included studies can be found in Table 1.

Risk of bias within studies

Risk of bias within the individual studies was assessed using the PEDro scale and results are as follows. One study scored 6/10,[30] two scored 7/10,[26,29] and 3 scored 8/10.[27,28,31] No studies met criteria five (blinding of all subjects) and six (blinding of therapists administering therapy) due to the constraints of study design and inability to effectively blind the patients and physical therapists to the interventions. Table 2 provides full details of the PEDro scoring for all included studies.

Self-Report Outcomes for Pain and Disability

The results for two studies[29,31] that provided patient self-report pain outcomes involving means and standard deviations of between groups measures are reported in Table 3. Both studies analyzed longitudinal effects on pain and disability findings and neither study identified superior effects of manipulation versus a comparator group. Ironically, both involved imbalanced baseline findings; one[31] exhibiting significance differences in Oswestry Disability Questionnaire (ODQ) scores.

The remaining four studies[26-28,30] that evaluated mean between group differences (and 95% confidence intervals) are reported in Table 4. Outcomes measures included the ODQ, and the pain measures of temporal summation (reported as 0 to 100) using either the Numeric Pain Rating Scale (NPRS), and the Visual Analog Scale (VAS) for pain. In all four studies,[26-28,30] manipulative therapy (and in one case manipulation and exercise[30]) demonstrated significant improvements over the comparator groups. Comparative groups consisted of use of a stationary bicycle, lumbar extension exercises, non-thrust mobilization, exercise, and ultrasound.

Additional Outcomes Measures

Additional measures at baseline and follow up were also captured by two of the six studies[27,29] and is reported in Table 5. Childs and colleagues[27] reported differences in medication use, pursuance of treatment for LBP, and work lost between those who received manipulation and those who did not and found significant improvements in all categories associated with those who received manipulation. Hallegraeff et al[29] measured differences in spinal mobility but found no differences between groups. Many other studies performed multiple additional measures at baseline examination, but failed to report follow up measures.

Effect Size Calculations

Only two studies reported means and standard deviations.[29,31] Hallegraeff and colleagues[29] reported effect sizes of 0.31 favoring manipulation for pain at 2.5 weeks and 0.0 favoring no intervention on disability percentage. Venegas-Rios et al [31] reported effect sizes of 0.08 and 0.19 for pain at 1 week and 4 weeks respectively, each favoring the manipulation and exercise group and effect sizes of 0.48 and 0.45 for the ODQ, favoring manipulation and exercise. The authors also reported effect sizes of 0.005 and 0.07 at 1 week and 4 weeks respectively with the Roland Morris Disability Questionnaire, suggesting no real benefit of one intervention over the other.

Risk of bias across studies

There were several common instances of potential bias across the included studies. First, most studies used subjective outcome measures to determine the effectiveness of selected interventions. This, by definition, creates the potential for self-report bias and inaccurate outcomes. Secondly, the design of the studies did not allow for adequate blinding of the therapists, which may lead to expectation bias. Finally, there were no true control groups in any of the six studies. This design does not account for the possibility of spontaneous recovery that may occur naturally in some cases of acute nonspecific LBP.

Adverse Effects

Only one study[28] reported the presence of adverse effects. Cleland et al[28] found that 25 percent of patients within the study reported these side effects. Nine patients in each spinal manipulation group reported side effects, whereas 10 patients in the non-thrust manipulation (comparative) group reported such effects. Although no serious complications were reported, the most common side effects included aggravation of symptoms and stiffness. All adverse effects were reported to be resolved within 48 hours of onset.

Table 1. *Characteristics of Individual Studies.*

Author (year)	Participants Details	Inclusion Criteria	Exclusion Criteria	SM Group Intervention No. sessions Duration Participants	CG1 Intervention No. sessions Duration Participants	CG2 Intervention No. sessions Duration Participants	Outcome Measures
Bialosky et al[26] (2009)	36 initial participants 0 Drop outs Mean Age (S.D.): SM =29.58 y (11.07) CG1=34.33 y (13.96) CG2=33.25 y (13.27) Females (%): SM = 8 (67) CG1 = 6 (50) CG2 = 12 (100)	Age: 18-60 y Current LBP	Non-English speaking Systemic medical conditions Psychiatric medications Pregnancy S&S of nerve root compression History of surgery to low back	HVLA 1 session 5 minutes n = 12	Stationary bike, 60-70 rpm 1 session 5 minutes n = 12	Prone low back extension exercise, 3 sets of 15 repetitions 1 session 5 minutes n = 12	Aδ fiber-mediated pain sensitivity Temporal summation
Childs et al[27] (2004)	131 initial participants 12 Drop outs Mean Age (S.D.): SM = 33.3 y (11.2) CG1= 34.6 y (10.6) Females (%): SM = 30 (42.9) CG1 = 25 (41)	Age: 18-60 y LBP ODQ ≥ 30%	Presences of any red flags Signs of nerve root compression Pregnancy History of surgery to low back or buttocks	HVLA, ROM exercies 5 sessions 4 weeks n = 70	Low stress aerobic and lumbar spine strengthening program 5 sessions 4 weeks n = 61	- - - -	ODQ Self-reported pain scores
Cleland et al[28] (2009)	112 initial participants 0 Drop outs Mean Age (S.D.): SM = 43.7 y (10.4) CG1 = 37.1 y (11.5) CG2 = 40.1 y (12.0) Females (%): SM = 17 (46) CG1 = 21 (56) CG2 = 19 (51)	Age: 18-60 y ODQ > 25% Positive for spinal manipulation CPR	Presences of any red flags Signs of nerve root compression Pregnancy History of surgery to low back	Supine HVLA, spinal ROM exercises, strengthening and stabilization exercises 5 sessions 4 weeks n =37	Side-Lying HVLA, spinal ROM exercises, strengthening and stabilization exercise s 5 sessions 4 weeks n = 38	Posterior-anterior nonthrust mobilization, spinal ROM exercises, strengthening and stabilization exercises 5 sessions 4 weeks n = 37	ODQ Numeric Pain Rating Scores

Table 1. *Characteristics of Individual Studies. (continued)*

Author (year)	Participants Details	Inclusion Criteria	Exclusion Criteria	SM Group Intervention No. sessions Duration Participants	CG1 Intervention No. sessions Duration Participants	CG2 Intervention No. sessions Duration Participants	Outcome Measures
Hallegraeff et al[29] (2009)	64 initial participants 1 Drop out Mean Age: SM = 38 y CG = 40 y Females (%): SM = 14 (41) CG1 = 15 (33)	Age: 20-55 y Acute Nonspecific LBP < 16 days With or without previous complaints No symptoms distal of the knee	Specific low back pain Neurological signs Specific rheumatic diseases Signs of osteoporotic fractures Inability to fill in research questionnaires	HVLA, standard physical therapy 4 sessions 2.5 weeks n = 31	Standard physical therapy 4 sessions 2.5 weeks n = 33	- - - -	VAS for pain ODQ Sit-and-Reach Test Subjective Patient Report of Improvement
Mosheni-Bandpei et al[30] (2006)	120 initial participants 8 Drop outs Mean Age (S.D.): SM = 34.8 y (10.6) CG1 =37.2 y (10.2) Females (%): SM = 34 (61) CG1 = 32 (57)	Age: 18-55 y LBP between L1-L5 and sacroiliac joints LBP > 3 months S&S referred from lumbar spine Good self-reported health Literate Speak & understand English	History of treatment Receiving disability benefits Malignancy Obvious disc herniation Osteoporosis Viscerogenic causes Infection or systemic disease of MS system Neurologic or sciatic nerve root compression Radicular pain Sensory disturbances Loss of strength and reflexes Previous vertebral fractures Major structural abnormalities Spine tumor Pregnancy Pacemakers	HVLA, exercise program Between 2-7 sessions - n = 56	Exercise program, continuous US, Between 3-11 sessions - n = 56	- - - -	VAS for pain ODQ Modified-modified Schober's test Surface EMG Muscle endurance

Table 1. *Characteristics of Individual Studies. (continued)*

Author (year)	Participants Details	Inclusion Criteria	Exclusion Criteria	SM Group Intervention No. sessions Duration Participants	CG1 Intervention No. sessions Duration Participants	CG2 Intervention No. sessions Duration Participants	Outcome Measures
Venegas-Rios et al[31] (2009)	66 initial participants 5 Drop outs Mean Age (S.D.): SM: 40.69 y (9.03) CG1: 42.59 y (10.62) Females (%): SM: 16 (48.5) CG1: 17 (51.5)	Age: 21-65 y New referrals of patients with complaints of chronic LBP	Patients on follow-up appointments LBP caused by systemic or organic diseases Psychiatric disorders Pregnancy Acute sever pain needing immediate treatment or surgery History of back surgery, fractures, or osteoporosis CNS involvement Nerve root involvement from lumbar disc extrusion Lumbar disc sequestration Severely decreased DTR Severely decreased myotomal sensation Severely decreased MMT compared to contralateral side	HVLA, conventional physical therapy - - n = 33	Conventional physical therapy - - n = 33	- - - -	VAS for pain ODQ Roland-Morris Disability Questionnaire Fear Avoidance Beliefs Questionnaire

SM = spinal manipulation; CG = control group; S.D.= standard deviation; y = years old; LBP = low back pain; S&S = signs and symptoms; HVLA = High-Velocity Low-Amplitude thrust manipulation; ODQ = Oswestry Low Back Pain Disability Questionnaire; CPR = clinical prediction rule; Standard Physical Therapy = gradually increasing the level of physical activity and improving the relevant physical functions, such as muscle strength, exercise capacity, and mobility; VAS = Visual Analogue Scale; MS = musculoskeletal; US = ultrasound at 1 MHz, 1.5 & 2.5 W/cm^2, 5-10 minutes; EMG = electromyography; DTR = deep tendon reflexes; MMT = manual muscle test.

Table 2. *Methodological quality of included studies using the PEDro Scale.*

Author, year	1	2	3	4	5	6	7	8	9	10	11	Total
Bialosky et al., 2009	X	X	X	X				X	X	X	X	7/10
Childs et al., 2004	X	X	X	X			X	X	X	X	X	8/10
Cleland et al., 2009	X	X	X	X			X	X	X	X	X	8/10
Hallegraeff et al., 2009	X	X	X	X				X	X	X	X	7/10
Mohseni-Bandpei et al., 2006	X	X		X			X	X		X	X	6/10
Venegas-Rios et al., 2009	X	X	X	X			X	X	X	X	X	8/10

Criteria: 1. Eligibility criteria specified. 2. Random subject allocation. 3. Allocation was concealed. 4. Groups were similar at baseline. 5. Blinding of all subjects. 6. Blinding of therapists administering therapy. 7. Blinding of assessors. 8. Measures obtained from more than 85% of initial subjects. 9. All subjects received treatment or control. If not, data was analyzed by "intention to treat. 10. Results of between-group comparisons reported for at least one key outcome. 11. Provides both point measures and measures of variability for one key outcome. PEDro item 1. Eligibility criteria specified is not used to calculate the overall PEDro score. X = criteria was satisfied.

Table 3. *Self-Report of pain and functional outcome results, demonstrating mean scores and standard deviations at time frames.*

Author (year)	Outcome measure	Time point	Manipulation Group Mean score (SD)	Comparative Group Mean score (SD)	p Value
Hallegraeff et al.[29] (2009)	VAS (0-100)	Baseline 2.5 weeks	42.7 (18.4) 19.0 (16.9)	54.0 (17.5) 24.8 (20.1)	N/R p = 0.26
	Disability %	Baseline 2.5 weeks	24.0 (18%) 14.0 (17%)	26.0 (12%) 14.0 (12%)	p = N/R p = 0.38
Venegas-Rios et al.[31] (2009)	VAS (0-100) Intensity of pain	Baseline 1-week 4-week	58.61 (20.7) 43.94 (23.1) 41.12 (27.3)	55.52 (15.6) 46.76 (24.1) 46.45 (27.6)	p=0.49 N/R N/R
	ODQ (0-50)	Baseline 1-week 4-week	15.85 (6.1) 13.06 (7.7) 12.97 (8.3)	19.82 (7.2) 17.15 (9.1) 17.12 (9.7)	p=0.02 N/R N/R
	RMDQ (0-24)	Baseline 1-week 4-week	9.67 (4.3) 8.70 (5.0) 8.55 (5.2)	10.39 (4.3) 8.67 (5.3) 8.94 (5.9)	p=0.49 N/R N/R

All findings are reported as means and standard deviations for between groups changes at dedicated time points. NPRS = Numeric Pain Rating Scale; N/R = Not Reported; ODQ = Oswestry Disability Questionnaire; VAS = Visual Analog Scale; Disability, % = percentage of ODQ scores; NS = non-significant; RMDQ = Roland Morris Disability Questionnaire; SD = Standard Deviation.

Table 4. *Mean between group differences (95% confidence intervals) in self-reported pain and functional outcome measures at time frames.*

Author (year)	Outcome measure	Assessment Time Point	Mean Between Group Differences (95% CI) / SD	Favorable Intervention	p-Value
Bialosky et al.[26] (2009)	Temporal Summation of Pain (0-100) *SMT vs. Stationary Bike*	Post-Intervention	12.3 (0.4 to 24.1)	SMT	p<0.05
	Temporal Summation of Pain (0-100) *SMT vs. Lumbar Extension Exercises*	Post-Intervention	6.0 (-5.8 to 17.8)	N/A	NS
Childs et al.[27] (2004)	ODQ (0-50) *SMT versus Exercise*	Baseline 1 week 4 weeks 6 months	0.5 (N/R) 9.2 (4.4 to 14.1) 8.3 (2.4 to 14.2) 10.1 (4.3 to 15.9)	N/A SMT SMT SMT	>0.20 <0.01 <0.01 <0.01
Cleland et al.[28] (2009)	NPRS (0-10) *Sidelying SMT vs. Nonthrust*	Baseline 1-week 4-week 6-month	0.1 1.5 (0.8 to 2.1) 1.3 (0.5 to 2.2) 0.4 (-0.3 to 1.1)	N/A SMT SMT N/A	NS p<0.01 p<0.01 p=0.29
	NPRS (0-10) *Supine SMT vs. Nonthrust*	Baseline 1-week 4-week 6-month	0.3 2.1 (1.2 to 2.9) 1.8 (0.7 to 2.9) 0.6 (-0.3 to 1.4)	N/A SMT SMT N/A	NS p<0.01 p<0.01 p=0.18
	ODQ (0-50) *Sidelying SMT vs. Nonthrust*	Baseline 1-week 4-week 6-month	2.4 7.9 (2.7 to 13.2) 12.7 (7.5 to 17.9) 6.8 (2.3 to 11.4)	N/A SMT SMT SMT	NS p<0.01 p<0.01 p=0.03
	ODQ (0-50) *Supine SMT vs. Nonthrust*	Baseline 1-week 4-week 6-month	1.0 11.5 (5.3 to 17.6) 14.2 (8.0 to 20.4) 5.9 (0.7 to 11.3)	N/A SMT SMT SMT	NS p<0.01 p<0.01 p=0.03
Mohseni-Bandpei et al.[30] (2006)	VAS (0-100) Manipulation + *Exercise vs. Ultrasound + Exercise*	Baseline 6-months	2.0 16.4 (6.1 to 26.8) 30.8 17.9 (p=0.000) 16.7 (p=0.003)	N/A SMT + Exercise	NS p<0.01
	ODQ, (0-100%)	Baseline 6 months 6-month	1.4% 7.8% (2.4% to 13.2%)	N/A SMT +Exercise	NS p<0.01 NS p<0.01 p<0.01

All findings are reported as means differences and 95% confidence intervals for between groups changes at dedicated time points. NPRS = Numeric Pain Rating Scale; N/R = Not Reported; ODQ = Oswestry Disability Questionnaire; VAS = Visual Analog Scale; Disability, % = percentage of ODQ scores; NS = non-significant;

Table 5. *Results of additional outcomes involving mean scores and standard deviations and means differences.*

Author, year (reference)	Additional outcomes	Time point	SMT Mean score (SD) / Mean Differences (95% CI)	CG1 Mean score (SD) / Mean Differences (95% CI)	Favorable Intervention	p-Values
Childs et al.,[27] (2004)	Medication for LBP (%)	6-month	36.5%	60.0%	SMT	P<0.05
	Treatment for LBP (%)	6-month	11.5%	42.5%	SMT	p<0.05
	Work lost in past 6 weeks (%)	6-month	9.6%	25.0%	SMT	p<0.05
Hallegraeff et al.,[29] (2009)	Spinal Mobility (mm)	Baseline 2.5 weeks	31.0 (7.6) 35.1 (8.5)	29.7 (7.7) 35.2 (7.8)	NA NA	N/R P=0.14

LBP = Low Back Pain; NA = Not applicable; N/R = Not reported; SMT = Spinal Manipulative Therapy; mm = Millimeters

DISCUSSION

Summary of evidence

Six randomized controlled trials were reviewed in order to determine the effectiveness of physical therapy spinal manipulations for patients with LBP. We calculated effect sizes for those studies[29,31] that reported means and standard deviations. Effect sizes ranged from minimal to moderate for the outcomes measures. Worth noting is that the most robust effect size was associated with the use of the ODQ, a finding that yielded no effect when the same patients were evaluated with the Roland Morris Disability Questionnaire.[29] In addition to the variations found with the instruments used to capture outcomes, variability in the findings is likely associated with study design differences, differences in the severity level of the patients, and potentially differences in the comparative intervention provided within each study.

All studies[26-28,30] that reported mean differences and 95% confidence intervals found positive effects favoring manipulation (or manipulation and exercise) versus a comparator group. Improvements were significant in all cases for up to six months for disability scores and up to four weeks generally for pain oriented scores. Bialosky and colleagues[26] reported improvements in temporal summation of pain (addition of stimuli over time) for those who received manipulation over lower back extension and stationary cycling as well.

The findings of this systematic review suggest that physical therapists have contributed to the growing wealth of literature that describes the effectiveness of spinal manipulation for the treatment of LBP. Although there was some inconsistency regarding the degree of effectiveness, all included studies in this systematic review reported data that supported the clinical usefulness of spinal manipulation provided by physical therapists. Previous systematic reviews have proposed that spinal manipulation can improve clinical outcomes, but its efficacy compared to other common intervention has not been clearly demonstrated.[1,4,32,33] The results of this systematic review indicate that physical therapy spinal manipulation of the lumbar spine is an effective form of intervention for a variety of patients with low back pain, although the degree of effectiveness is variable between studies.

Only one study reported adverse effects of manipulation. Cleland et al[28] showed that the non-thrust manipulation group (the sham comparative measure) actually reported more adverse effects than the two experimental thrust manipulation groups. The non-thrust manipulation group consisted of posterior to anterior mobilizations to the spinous processes of L4 and L5, and did not take into account

patient feedback during the procedure. The techniques can be potentially irritating, which was similar to the minor adverse reactions reported by Cleland and associates.[28] Cleland et al's[28] findings of only minor adverse reactions are consistent with a systematic review by Bronfort et al[32] which reported that serious or severe complications from spinal manipulations are rare. Certainly, future studies should more diligently report adverse events encountered during the study timeframe.

To the authors' knowledge, this is the first systematic review to examine the effectiveness of physical therapy spinal manipulation for LBP. One notable finding is that the majority of the studies examined only changes in pain and disability. Also, it should be noted that within the literature[34] it has been reported that pain rating scales and ODQ measures are strongly correlated and may measure similar aspects of subjective pain reporting. Deyo et al[35] suggests using a variety of outcome variables to truly reflect the complexity and multiple dimensions of LBP. Some notable outcomes proposed to be included in future studies are general well-being, work disability, satisfaction with care, and cost effectiveness. The one study[27] examined in this systematic review that reported such outcomes supported the use of physical therapy spinal manipulation.

Limitations

This systematic review had a number of limitations. The search strategy was limited to include only studies published in English. Furthermore, none of the studies meeting the inclusion criteria obtained outcome measure data beyond six months following the treatment period. This limits the reporting of the long-term effects of physical therapy spinal manipulation for patients with LBP.

CONCLUSIONS

Physical therapy spinal manipulation appears to be a safe intervention that improves clinical outcomes for a variety of patients with LBP. Based on current literature, physical therapists should continue to use this intervention as one of many options to treat LBP. The authors of this systematic review suggest that further research be completed on this topic in an attempt to provide longer follow-up time periods and outcome measures which cover all significant components of patient outcomes.

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APPENDIX 1. COMPREHENSIVE SEARCH STRATEGY FOR ALL DATABASES

Database: PubMed

#1 MeSH descriptor Low Back Pain, explode all trees
#2 MeSH descriptor Back Pain, explode all trees
#3 MeSH descriptor Lumbosacral Region, explode all trees
#4 MeSH descriptor Back, explode all trees
#5 MeSH descriptor Back Injuries, explode all trees
#6 "low back"
#7 "low back pain"
#8 lumbar
#9 lumbago
#10 "back pain"
#11 backache
#12 lumbosacral
#13 lbp
#14 [OR #1 - #13]
#15 MeSH descriptor Manipulation, Spinal, explode all trees
#16 MeSH descriptor Manipulation, Orthopedic, explode all trees
#17 MeSH descriptor Manipulation, Osteopathic, explode all trees
#18 manip*
#19 mobiliz*
#20 mobilis*
#21 "thrust"
#22 "grade 5"
#23 "high velocity"
#24 osteopath*
#25 [OR 15# - #24]
#26 MeSH descriptor Recovery of Function, explode all trees
#27 MeSH descriptor Health Care Costs, explode all trees
#28 MeSH descriptor Cost-Benefit Analysis, explode all trees
#29 MeSH descriptor Pain Measurement, explode all trees
#30 MeSH descriptor Comparative Effectiveness Research, explode all trees
#31 MeSH descriptor Treatment Outcome, explode all trees
#32 MeSH descriptor Program Evaluation, explode all trees
#33 MeSH descriptor Quality of Life, explode all trees
#34 MeSH descriptor Outcome Assessment (Health Care), explode all trees
#35 MeSH descriptor Office Visits, explode all trees
#36 recovery of function
#37 compara*
#38 compare*
#39 "cost-benefit"
#40 pain measur*
#41 effect*
#42 outcome*
#43 quality of life
#44 cost
#45 benefi*
#46 [OR #26 - #45]
#47 Clinical Trial [Publication Type]
#48 Randomized Controlled Trial [Publication Type]
#49 Comparative Study [Publication Type]
#50 Controlled Clinical Trial [Publication Type]
#51 Evaluation Studies [Publication Type]
#52 MeSH descriptor Random Allocation, explode all trees
#53 MeSH descriptor Follow-Up Studies, explode all trees
#54 random*
#55 clinical trial
#56 controlled trial
#57 [OR #47 - #56]
#58 [#14 AND #25 AND #46 AND #57]

Limits: Studies involving humans and publications in the English Language

Database: CINAHL

#1 MeSH descriptor Low Back Pain
#2 MeSH descriptor Back Pain, explode all trees
#3 MeSH descriptor Back Injuries, explode all trees
#4 MeSH descriptor Lumbar Vertebrae
#5 "low back pain"
#6 "low back"
#7 lumbago
#8 lbp
#9 lumbosacral

#10 lumbar
#11 "back pain"
#12 backache
#13 [OR #1 - #12]
#14 MeSH descriptor Manipulation, Orthopedic
#15 MeSH descriptor Manipulation, Osteopathic
#16 manip*
#17 mobiliz*
#18 mobilis*
#19 "thrust"
#20 "high velocity"
#21 osteopath*
#22 [OR #14 - #21]
#23 MeSH descriptor Recovery
#24 MeSH descriptor Functional Assessment, explode all trees
#25 MeSH descriptor Functional Status
#26 MeSH descriptor Costs and Cost Analysis, explode all trees
#27 MeSH descriptor Health Care Costs, explode all trees
#28 MeSH descriptor Cost Benefit Analysis
#29 MeSH descriptor Pain Measurement
#30 MeSH descriptor Clinical Effectiveness
#31 MeSH descriptor Treatment Outcomes, explode all trees
#32 MeSH descriptor Outcome Assessment
#33 MeSH descriptor Outcomes Research
#34 MeSH descriptor Quality of Care Research
#35 MeSH descriptor Quality of Health Care, explode all trees
#36 MeSH descriptor Quality Assessment, explode all trees
#37 MeSH descriptor Quality Improvement, explode all trees
#38 MeSH descriptor Quality of Life, explode all trees
#39 MeSH descriptor Office Visits
#40 recovery of function
#41 compar*
#42 "cost-benefit"
#43 pain measure*
#44 effect*
#45 outcome*
#46 quality of life
#47 cost
#48 benefi*
#49 [OR #23 - #48]
#50 MeSH descriptor Evaluation Research, explode all trees
#51 MeSH descriptor Formative Evaluation Research
#52 MeSH descriptor Summative Evaluation Research
#53 MeSH descriptor Program Evaluation
#54 MeSH descriptor Comparative Studies
#55 MeSH descriptor Clinical Trials, explode all trees
#56 MeSH descriptor Randomized Controlled Trials
#57 MeSH descriptor Random Sample, explode all trees
#58 random*
#59 clinical trial
#60 controlled trial
#61 [OR #50 - #60]
#62 [#13 AND #22 AND #49 AND #61]

Limits: Publications in the English Language

Database: Scopus, ProQuest Nursing & Allied Health Source

#1 "low back pain"
#2 lumbago
#3 lumbosacral
#4 lbp
#5 [#1 OR #2 OR #3 OR #4]
#6 manip*
#7 mobiliz*
#8 mobilis*
#9 [#6 OR #7 OR #8]
#10 compar*
#11 effect*
#12 benefi*
#13 [#10 OR #11 OR #12]
#14 "clinical trial"
#15 "randomized controlled trial"
#16 "controlled trial"
#17 [#14 OR #15 OR #16]
#18 [#5 AND #9 AND #13 AND #17]

Limits: Peer reviewed articles from scholarly journals published in the English Language

Database: SPORTDiscus

#1 DE "BACKACHE"
#2 DE "BACK"

#3 DE "LUMBOSACRAL region"
#4 DE "LUMBAR vertebrae"
#5 DE "SACROCOXALGIA"
#6 low back pain
#7 lumbar
#8 lumbago
#9 backache
#10 lumbosacral
#11 lbp
#12 [OR #1 - #11]
#13 DE "MANIPULATION (Therapeutics)"
#14 DE "SPINAL adjustment"
#15 manip*
#16 mobiliz*
#17 mobilis*
#18 osteopath*
#19 "thrust"
#20 "grade 5"
#21 "high velocity"
#22 [OR #13 - #21]
#23 DE "PAIN -- Measurement"
#24 DE "QUALITY of life"
#25 DE "HEALTH status indicators"
#26 recovery of function
#27 compar*
#28 cost benefit
#29 pain measur*
#30 effect*
#31 outcome*
#32 quality of life
#33 cost
#34 benefi*
#35 [OR #23 - #34]
#36 clinical trial
#37 randomized controlled trial
#38 "controlled trial"
#39 random*
#40 [OR #36 - #39]
#41 [#12 AND #22 AND #35 AND #40]

Limits: Publications in the English Language

Database: Cochrane Central Register of Controlled Trials

#1 low back pain
#2 lumbar
#3 lumbago
#4 backache
#5 lumbosacral
#6 lbp
#7 [OR #1 - #6]
#8 manip*
#9 mobiliz*
#10 mobilis*
#11 osteopath*
#12 "thrust"
#13 "grade 5"
#14 "high velocity"
#15 [OR #8 - #14]
#16 recovery of function
#17 compar*
#18 cost benefit
#19 pain measur*
#20 effect*
#21 outcome*
#22 quality of life
#23 cost
#24 benefi*
#25 office visits
#26 [OR #16 - #25]
#27 clinical trial
#28 randomized controlled trial
#29 "controlled trial"
#30 random*
#31 [OR #27 - #30]
#32 [#7 AND #15 AND #26 AND #31]

Limits: Publications in the English Language